MOUNT STIRLING G-E-M

RESOURCES AREA

(GRA NO. NV-31)

TECHNICAL REPORT

(WSAs NV 050-401)

Contract YA-554-RFP2-1054

Prepared By

Great Basin GEM Joint Venture
251 Ralston Street
Reno, Nevada 89503

For

Bureau of Land Management
Denver Service Center
Building 50, Mailroom
Denver Federal Center
Denver, Colorado 80225

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EXECUTIVE SUMMARY

The Mt. Stirling Geology-Energy-Minerals (GEM) Resource Area (GRA) is 25 miles northwest of Las Vegas in Clark and Nye Counties, Nevada. It covers the northwestern end of the Spring Mountains. There is one Wilderness Study Area (WSA), NV 050-401.

The entire GRA is underlain by sedimentary rocks 250 million years to 650 million years old; all of the rocks in the WSA are more than 400 million years old. No igneous rocks are known in the GRA. Several sets of faults displace the rocks, including some large thrust faults that have moved older rocks to overllie younger rocks.

Just west of the north end of the WSA is the Johnnie district, which is said to have produced more than $1 million in gold -- perhaps $10 million at 1980s prices. In a re-entrant in the north boundary of the WSA is the informal Stirling district which probably produced a little gold; some of the prospects of this district are within the WSA. At the south edge of the WSA, just outside it, is the El Lobo property that has produced a few tons of lead-silver ore. Both lead and silver are strategic metals.

The only patented claims in the GRA are in the Johnnie district; some of them are very close to the WSA but apparently are not inside it. Most unpatented claims are in the Johnnie district or in the Stirling district, and a few of the latter are well within the WSA. There are also a few unpatented claims in the vicinity of the El Lobo property at the south edge of the WSA district, some of which may lie within the WSA. There are no Federal geothermal leases, but most of the GRA is covered with oil and gas leases.

The northwest part of the WSA is classified as moderate for metallic minerals with low confidence, as part of a postulated gold district extending from Johnnie to Stirling. Part of the southeast edge is classified highly favorable for lead-silver mineralization in a thrust fault with moderate confidence, and part is classified as having low favorability for possible similar mineralization with very low confidence. The remainder of the WSA is classified as having very low favorability, with low confidence for metallic minerals. Almost the entire WSA is classified as having low favorability for uranium with low confidence, but a small part in the northeast corner is classified as having low favorability with very low confidence. The entire WSA has very low favorability with very low confidence for thorium. The western part of the WSA is classified as having low favorability for nonmetallic minerals with low confidence, and a small part of the northeast corner is classified as moderately favorable for sand and gravel with moderate confidence; the remainder is classified as moderately favorable for limestone and dolomite with moderate confidence. The classification for oil and gas is very

low favorability with very low confidence and that for geothermal is low favorability with very low confidence.

Reconnaissance geological mapping and geochemical stream sediment sampling is recommended to test the validity of the postulated district in the WSA between Johnnie and Stirling. Geochemical soil sampling is recommended to determine the extent of lead-silver mineralization along a thrust fault at the southeast edge of the WSA.

I. INTRODUCTION

The Mount Stirling G-E-M Resources Area (GRA No. NV-31) contains approximately 210,000 acres (860 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Mount Stirling	NV 050-401

The GRA is located in Nevada in the Bureau of Land Management's (BLM) Stateline/Esmeralda Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 36°30' north latitude, 116°00' west longitude and includes the following townships:

T 16 S, R 53-55 E
T 17 S, R 53-55 E
T 18 S, R 53-55 E
T 19 S, R 54,55 E

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

15-minute:

Mount Stirling

7.5-minute:

Mt. Shader

The nearest town is Cactus Springs which is located two miles northeast of the northeast corner of the boundary, along U. S. Highway 95. Access to the area is via U. S. Highway 95 to the north, and State Route 16 and 52 to the west and south. Access within the area is via unimproved light duty and dirt roads throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

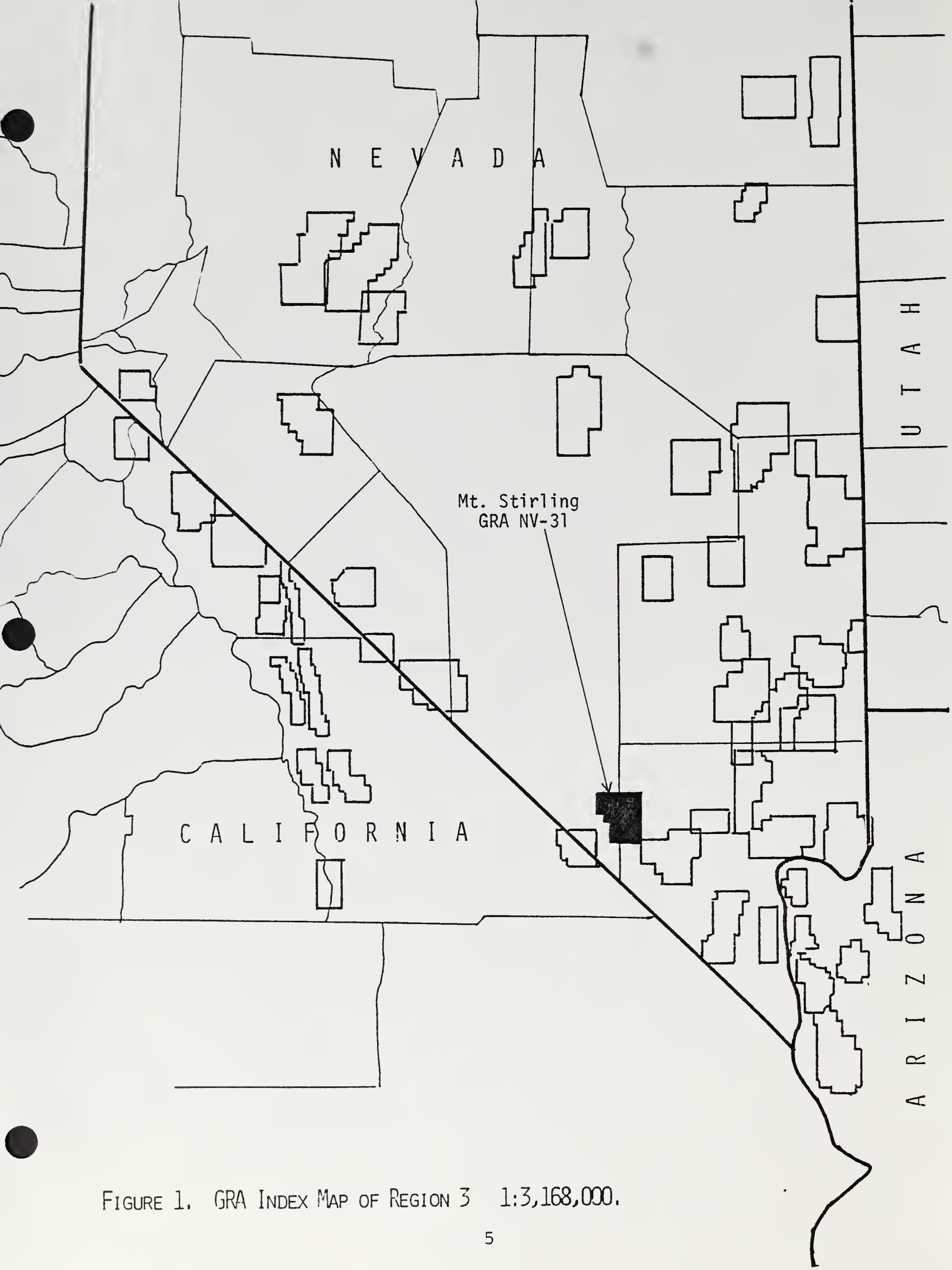
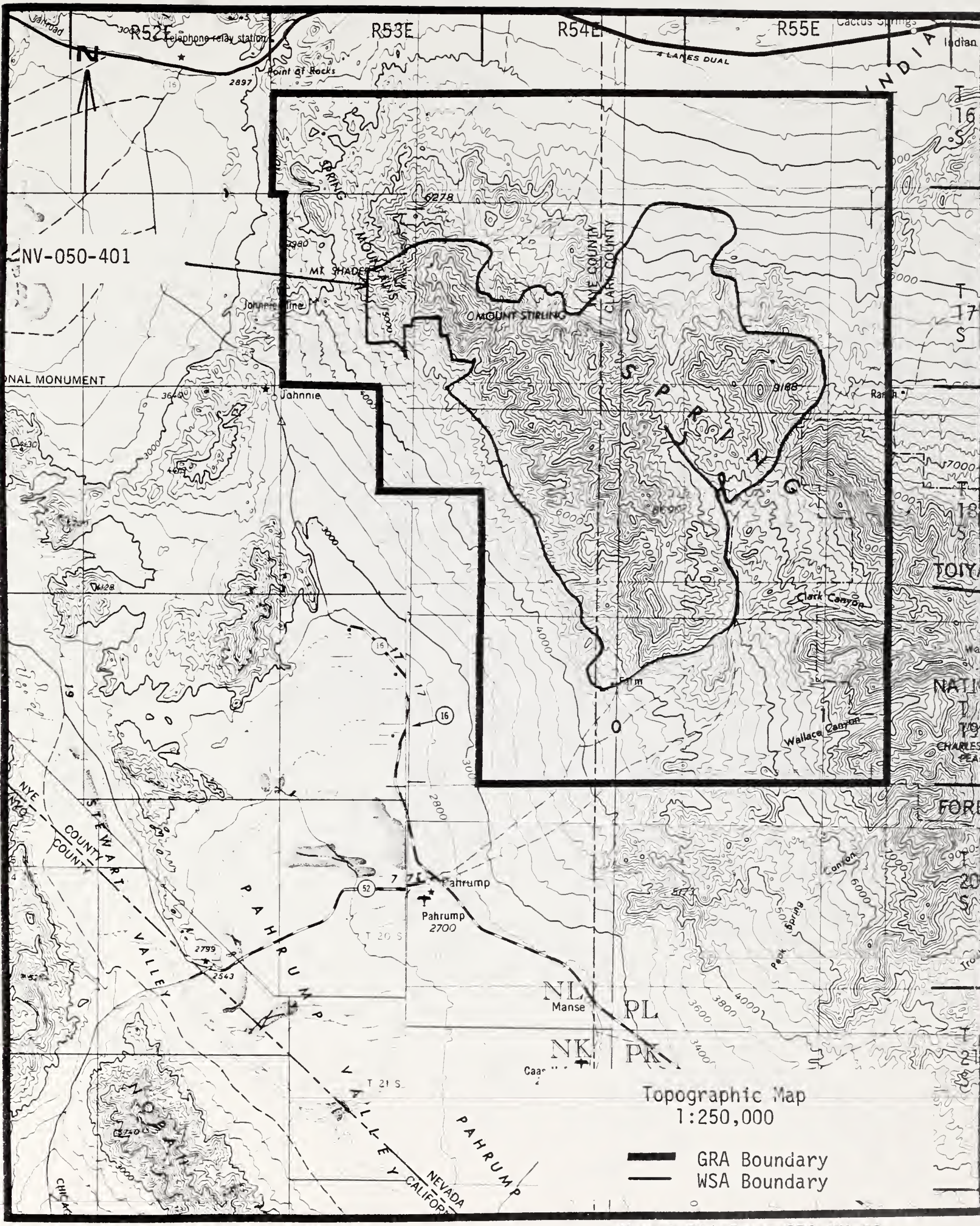


FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Death Valley and Las Vegas Sheets

Mount Stirling GRA NV-31

Figure 2

Geologic Map
1:250,000

See next page for explanation

Cornwall (1972); Streitz and Stinson (1965)

Mount Stirling GRA NV-31

Figure 3

E X P L A N A T I O N

QUATERNARY — *Pleistocene and Holocene*

Qb — Basalt
Flows, plugs, and cinder cones

Qal — Alluvium
Fan and stream gravels flanking mountains and hills and grading outward into sands and silts in valley bottoms

Qp — Playa lake deposits

TERTIARY AND QUATERNARY — *Pliocene and Pleistocene*

QTal — Older alluvium
Boulders, cobbles, and finer material of varied lithology in older partly dissected fans

TERTIARY

Pliocene

Tb — Basalt
Flows and plugs

Tth — Thirsty Canyon Tuff
Comenditic and pantelleritic ash-flow and ash-fall tuff

Tw — * Welded tuff
Ash flows, mostly rhyolitic; locally includes older ash flows

Tt — *Ash-fall tuff and nonwelded ash-flow tuff

Ttr — Trachyte
Flows and intrusive masses

Tl — * Quartz latite
Flows and intrusive masses

Trb — Rhyolite of Black Mountain
Flows

Miocene and Pliocene

Tp — Timber Mountain (Pliocene) and Paintbrush Tuffs and tuff of Crater Flat (Miocene)
Includes ash-fall tuffs and conformably overlying Paintbrush and Timber Mountain Tuffs. Consists of rhyolitic ash-flow and minor ash-fall tuffs

Miocene

Tbr — Belted Range Tuff
Comenditic ash-flow and ash-fall tuff

Ti — Indian Trail Formation
Includes rhyolite, rhyolitic ash-flow, and ash-fall tuff; locally includes older units around Yucca Flat

Tws — Wahmonie and Salyer Formations
Dacite, rhyodacite, and latite flows, breccias, tuffs, and tuffaceous sandstones, locally includes tuffaceous sediments underlying these formations

Ts — Tuffaceous sedimentary rocks

Tts — Tuff and tuffaceous sedimentary rocks

Tf — Fraction Tuff
Rhyolitic and quartz latitic ash flows

Tdv — Dacite vitrophyre
Dacitic ash flows

Td — Dacite and rhyodacite
Rocks of intermediate composition, includes flows and intrusive masses of dacite, less extensive rhyodacite, and minor andesite and quartz latite

Tg — Coarse-grained rhyolite porphyry intrusions

Tl — * Quartz latite
Flows and intrusions

Ta — Andesite
Flows and intrusive masses

Tr — Rhyolite
Flows and intrusive masses

Twb — Tuff of White Blotch Spring
Rhyolitic ash flows

Tma — Milltown Andesite
Andesite flows and intrusive masses

Twa — Tuffs of Antelope Springs
Welded ash-flow tuff

Oligocene or Miocene

Tm — Tuff of Monotony Valley
Rhyodacite and quartz latitic ash-flow and ash-fall tuff

Tt — *Ash-fall tuff and nonwelded ash-flow tuff

Tw — * Welded tuff
Ash flows, mostly rhyolitic

Oligocene

Ttc — Titus Canyon Formation
Conglomerate with interbedded sandstone, siltstone, limestone, and tuff

MESOZOIC OR TERTIARY

mb — Megabreccia
Landslide blocks of monolithologic dolomite breccia from Bonanza King Formation

EXPLANATION CONT.

MESOZOIC OR TERTIARY

mb

Megabreccia

Landslide blocks of monolithologic dolomite breccia from Bonanza King Formation

MESOZOIC

Mzm

Intrusive masses of quartz monzonite and granodiorite

PENNSYLVANIAN

Lower Pennsylvanian

IPt

Tippipah Limestone

MISSISSIPPIAN

Mm [illegible]

[illegible]

DEVONIAN AND MISSISSIPPIAN

MDe

Eleana Formation

Interbedded argillite, dark chert conglomerate, quartzite, shale, and limestone

DEVONIAN

Middle and Upper Devonian

Dd

Devils Gate Limestone

Limestone, minor dolomite and lenticular quartzite

Lower and Middle Devonian

Dn

Nevada Formation

Dolomite, minor mudstone

Ddn

Devils Gate Limestone and Nevada Formation

SILURIAN AND DEVONIAN

DSu

Dolomitic sedimentary rocks undivided

SILURIAN

Middle

Slm

Lone Mountain Dolomite

Srm

Roberts Mountains Formation

Platy dolomite and limestone

Su

Sedimentary rocks, undivided

Dolomite, minor limestone

Pzu

Paleozoic sedimentary rocks, undivided

ORDOVICIAN

Middle and Upper Ordovician

Oee

Ely Springs Dolomite (Middle and Upper Ordovician) and Eureka Quartzite (Middle Ordovician)

Lower and Middle Ordovician

Op

Pogonip Group

Limestone, shaly limestone, and minor dolomite

CAMBRIAN

Upper Cambrian

Cn

Nopah Formation

Dolomite, limestone, and minor shale

Middle and Upper Cambrian

Cb

Bonanza King Formation

Dolomite and limestone with alternating light- and dark-gray beds

Ce

Emigrant Formation

Claystone and limestone

Lower and Middle Cambrian

Cc

Carrara Formation

Interbedded [illegible] limestone, siltstone, and minor [illegible] shale. Locally includes rocks [illegible] part of Emigrant [illegible] the Belted Range

Cz

[illegible] Quartzite

Cc

Formation

Cz

CAMBRIAN

€p€w

Wood Canyon Formation

Quartzite, [illegible] siltstone [illegible] shale and marble

p€s

Stirling Quartzite

Quartzite with interbedded [illegible] schist and minor marble

p€j

Johnnie Formation

Micaceous shale, fine-grained quartzite, and minor marble

p€u

Gneiss and schist, undivided

p€r

Reed Dolomite

p€w

Wyman Formation

Siltstone with limestone interbeds

PRECAMBRIAN

Contact

Dashed where approximately located

High-angle fault, showing dip and relative movement

Dashed where approximate, dotted where concealed. Ball is on downdropped side

Low-angle thrust fault showing dip

Dotted where concealed. Sawteeth on upper plate

Strike and dip of beds and compaction foliation in welded tuffs

Vertical   Overturned

Strike and dip of beds

Horizontal beds

Caldera

Mine shaft

Exploration shaft or adit

*Note: Repetition of this map unit within the column indicates known age differences

DESCRIPTION OF MAP UNITS

Symbol	Description
Qal	ALLUVIAL DEPOSITS (HOLOCENE AND PLEISTOCENE?)
Qp	PLAYA DEPOSITS (HOLOCENE AND PLEISTOCENE?)
Qc	CHEMEHUEVI FORMATION (PLEISTOCENE)
Ql	LAS VEGAS FORMATION (PLEISTOCENE)
Qm	CALICHE OF MORMON MESA (PLEISTOCENE)
Qrd	GRAVEL OF THE COLORADO AND VIRGIN RIVERS (LOWER PLEISTOCENE)
QTal	ALLUVIAL FAN DEPOSITS (QUATERNARY AND TERTIARY)
Tb	BASALT (PLIOCENE AND MIOCENE)
	MUDDY CREEK FORMATION (PLIOCENE? AND MIOCENE)
Tm	Claystone unit
Tmf	Fortification Basalt Member
Tpw	ASH-FLOW TUFF (MIOCENE)
Tp	ROCKS OF PAVITS SPRINGS (MIOCENE)
Thv	ROCKS OF THE HAMBLIN-CLEOPATRA VOLCANO (MIOCENE)
Thvi	INTRUSIVE ROCKS (MIOCENE)
Tmdv	MOUNT DAVIS VOLCANICS (MIOCENE)
	HORSE SPRING FORMATION (MIOCENE)
Ths	Sandstone and silver tuff
Thl	Rocks of Lovell Wash
Thb	Limestone of Bitter Ridge
Thl	Lower member
Tsu	UNDIFFERENTIATED SEDIMENTARY ROCKS (TERTIARY)
Kb	BASELINE SANDSTONE (UPPER AND LOWER CRETACEOUS)
Kwt	WILLOW TANK FORMATION (LOWER CRETACEOUS)
Ja	AZTEC SANDSTONE (JURASSIC)
℞mc	MOENAVE (UPPER TRIASSIC?) AND CHINLE (UPPER TRIASSIC) FORMATIONS
℞m	MOENKOPI FORMATION (MIDDLE? AND LOWER TRIASSIC)
Pkt	KAIBAB LIMESTONE AND TOROWEAP FORMATION (LOWER PERMIAN)
Pc	CLASTIC ROCKS (LOWER PERMIAN)
PPM	CALLVILLE LIMESTONE AND BIRD SPRING FORMATION (LOWER PERMIAN, PENNSYLVANIAN AND UPPER MISSISSIPPIAN)
Mm	MISSISSIPPIAN ROCKS
	DEVONIAN ROCKS
Dmp	Muddy Peak Limestone
Dms	Sultan Limestone
Sl	SILURIAN ROCKS
Ou	ORDOVICIAN ROCKS
OCu	UNDIFFERENTIATED ORDOVICIAN AND CAMBRIAN ROCKS
Cdl	CARBONATE ROCKS (UPPER AND MIDDLE CAMBRIAN)
Cu	UNDIFFERENTIATED CLASTIC ROCKS (MIDDLE AND LOWER CAMBRIAN)
C-Du	UNDIFFERENTIATED DEVONIAN THROUGH CAMBRIAN ROCKS
Pzu	UNDIFFERENTIATED PALEOZOIC ROCKS
pCsj	STIRLING QUARTZITE AND JOHNNIE FORMATION (PRECAMBRIAN)
pCum	ULTRAMAFIC ROCKS (PRECAMBRIAN)
pCgn	GNEISS AND SCHIST (PRECAMBRIAN)
pCrg	RAPAKIVI GRANITE (PRECAMBRIAN)

CONTACT

FAULT

THRUST FAULT

LOW-ANGLE FAULT

ANTICLINE

SYNCLINE

II. GEOLOGY

The Mount Stirling GRA lies within the Basin and Range geomorphic province and includes much of the northwest-trending northern portion of the Spring Mountains. The study area lies across the Clark-Nye County border.

The Spring Mountains consist of Paleozoic miogeosynclinal rocks which have been thrusted, folded and faulted by tectonic forces of the Sevier Orogeny during the Cretaceous. Basin and Range normal faulting, responsible for much of the present day topography occurred subsequent to regional volcanism during the late Miocene through Pliocene.

1. PHYSIOGRAPHY

The Mount Stirling GRA lies within the Basin and Range geomorphic province and includes much of the northwest-trending northern portion of the Spring Mountains. WSA 050-401, located in the center of the GRA, lies across the Nye County-Clark County border.

The Spring Mountains consist of complexely faulted and folded Paleozoic marine miogeosynclinal rocks. A major sinuous normal fault bounds the southwest flank of the Spring Mountains.

The Spring Mountains have a rugged topography with elevations along the crest of the range averaging about 7,000 feet.

The southwest half of the range has internal drainage with streams flowing into nearby playas at elevations of about 2,500 feet. The northeast side of the range drains into Las Vegas Valley which has similar elevation, and thence into the Colorado River. Deep wells in Las Vegas Valley supply much of the water for Clark County.

2. ROCK UNITS

The oldest rock unit in the Mount Stirling GRA is the Precambrian Johnnie Formation which consists of micaceous shale, fine-grained quartzite and minor marble. The Stirling Quartzite conformably overlies the Johnnie Formation and consists of quartzite with interbedded mica schist and minor marble.

The Cambrian Wood Canyon and Carrara Formations, which contain interbedded limestone, siltstone and micaceous shale were next deposited. These sediments host the structurally controlled gold mineralization of the Johnnie district on the southwest flank of the Spring Mountains. Dolomite and limestone of the Bonanza King Formation was laid down next and subsequently overlain by dolomite, limestone and minor shale of the Cambrian Nopah Formation (Cornwall, 1972).

The Ordovician Pogonip group consisting of limestone, shaly limestone and minor dolomite beds was deposited next. This formation was overlain by the Eureka Quartzite during the middle Ordovician.

An undivided sequence of dolomite with minor limestone was conformably deposited over the Eureka Quartzite in Silurian time.

The Lone Mountain Dolomite, also deposited during the Silurian, is the next youngest formation.

The widespread Sultan Limestone, deposited during the Devonian is the next youngest formation.

The five limestone members of the Monte Cristo Limestone were deposited during the Mississippian. Conformably overlying the Monte Cristo Limestone is the Bird Spring Formation which was deposited from the upper Mississippian through the Permian.

There are no igneous rocks, either intrusive or extrusive, in the GRA.

3. STRUCTURAL GEOLOGY AND TECTONICS

The northern Spring Mountains and surrounding areas consist of intensely deformed Late Precambrian to Permian sedimentary rocks. The thrusting, lateral faulting and related normal faulting in the Spring Mountains is probably genetically related to deformation along the Las Vegas shear zone that lies under the valley north of the GRA (Longwell and others, 1965). This deformation probably occurred near the middle of the Cretaceous with lesser deformation continuing into the Tertiary. Thrust faults have been identified in the northwest corner of the study area and along the southeastern border of WSA 050-401. Both have thrust Cambrian formations over younger rocks towards the southeast.

Numerous northwest-trending Basin and Range normal faults transect the Paleozoic sediments. Many of the east-west-trending normal faults in the area are terminated by northwest-trending normal faults indicating that they were formed earlier. Several large northwest-trending normal faults bound the northern Spring Mountains forming steep escarpments. Gold mineralization in the Johnnie district, on the southwest flank of the Spring Mountains is structurally controlled by Pliocene Basin and Range faults in Cambrian limestones, siltstones and shales (Cornwall, 1972).

4. PALEONTOLOGY

Several fossiliferous formations lie within the boundaries of the Mount Stirling GRA, and range in age from latest Precambrian through Permian (Wolfcampian), thus representing one of the most complete sections of marine Paleozoic in Nevada. Rocks equivalent to the Stirling Quartzite, usually unfossiliferous, are exposed in the western part of the area and are overlain by later Cambrian units of the Carrara and Bonanza King(?) Formations. These and the other Paleozoic units are discussed in detail by Stewart (1970), who cites a number of pertinent references.

Rocks of the Pogonip Group, occasionally fossiliferous, occur in the northern part of the study area; however, no localities are recorded from within the boundary of the GRA. Mississippian Limestones, partly recrystalized and devoid of fossils, and shales assignable to the Monte Cristo or equivalent formation are potentially fossiliferous and are exposed conformably below Pennsylvanian-Permian Bird Spring and Callvile Limestone, and above the Sevey and Simonson Dolomites. The Bird Spring is generally fossiliferous at least locally, and is exposed over much of the central part of the resource area. The literature provides abundant faunal lists from the Bird Springs (see, for example, Lane, 1963; Lane and Webster, 1966) but all localities so far encountered in this search fall outside the boundaries of the study area. It is however fair to say that virtually any exposure of Bird Spring or equivalent rocks has an unusually high probability for the occurrence of paleontological resources, and the fact they have not been recorded means only that the preservation and abundance is greater somewhere else.

Limited exposures of Silurian Laketown Dolomite, exposed north of Mount Charleston, has produced a few poorly preserved marine invertebrates, mostly brachiopods. Faunas from equivalent units to the north are listed by Tschanz and Pampeyan (1970).

It must be considered that the entire area of Paleozoic marine strata within the Mount Stirling GRA is a potential reservoir of paleontological resources, and that fossils may occur almost anywhere that suitable lithology is encountered. There are no fossils of younger age that are known from within the resource area or from adjacent areas.

5. HISTORICAL GEOLOGY

During the Paleozoic marine sediments of the Cordilleran miogeosyncline were deposited over Precambrian sediments and meta-sediments throughout the area.

Folding, thrusting, and strike-slip faulting caused by tectonic forces of the Sevier orogeny deformed the Precambrian and Paleozoic rocks mainly in Cretaceous time. Volcano-tectonic activity during the Miocene-Pliocene affected areas around the GRA, however, no volcanic rocks are identified in the study area.

Basin and Range faulting during the Pliocene formed much of the present day topography. Mineralization in the Johnnie district on the southwest flank of the range is structurally controlled by normal faults and probably occurred during the Late Tertiary.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

In the northwest corner of the GRA is the Johnnie district, which has recorded production of nearly $400,000 in gold and may have produced more than one million dollars -- perhaps $10 million at 1980s prices. Several mines, including the Johnnie, Labbe and Congress are known to have contributed to the production (Cornwall, 1972).

A few miles southeast of the GRA is the west edge of the Charleston district which includes most of the southeast side of the Spring Mountains. Although the area of the district is very large, only four mines scattered over this area are mentioned in the literature and none of them produced more than very small quantities of lead-silver-zinc ore.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

An adit symbol is shown in Sec. 36, T 17 S, R 53 E near Crystal Spring on the Mt. Stirling 15-minute topographic quadrangle (#1 on the Metallic Minerals Land Classification and Mineral Occurrence Map). It apparently is in Johnnie Formation rocks.

North of Mt. Stirling and just north of the west end of WSA NV 050-401 are the Stirling mine (#2) and a scattering of prospects over an area of about four square miles (Mt. Stirling 15-minute topographic quadrangle). Kral (1951) does not show these diggings on his map, and no other publication refers to them except for a uranium reference described later under the appropriate section of this report.

Field verification of this area was attempted on December 12, 1982, but snow down to 6,500 feet elevation on the north slopes made access to the diggings close to the WSA boundary impossible. Alongside the poor road in the SW 1/4 of Sec. 18, T 17 S, R 54 E (Mt. Stirling 15-minute topographic quadrangle) a pile of about five tons of white quartzite with abundant green copper oxide minerals was found. This is evidently material some miner hauled (by burro?) from a prospect higher in the range for eventual transfer to a truck and haulage to a smelter. Prospects shown by symbols on the map a quarter of a mile west of this pile apparently are in quartzite and may be the source of the material. They lie a short distance outside the WSA. Other prospect symbols plot within the WSA (#3).

In the SE 1/4 of Sec. 7, T 19 S, R 55 E an adit symbol is shown on the Mt. Stirling quadrangle (#4). This was visited during the field verification on December 12, 1982. Mr. Leon Hughes of Pahrump, the owner of the El Lobo 1-6 claims at the property, was on the site at the time. He says his adit is 300 feet long, but caved at one point with most of his equipment beyond the cave. He says that in 1950 he made a small shipment of ore that assayed 76 percent lead and a trace of silver to the Selby smelter, and that part of his dump averages 10 percent lead. He was cordial but asked that no samples be taken, so none were taken. He also says that lead minerals can be panned from the colluvium in a wide range -- a mile or so? -- around his property.

3. Mining Claims

The only patented mining claims in the GRA are in the vicinity of the Johnnie district. The easternmost patented claim(s) plot about on the westernmost border of WSA NV 050-401.

Unpatented claims in the GRA fall into three clusters. One cluster is in the vicinity of the Johnnie district, and the easternmost of these also plot about on the westernmost border of the WSA. Another rather scattered cluster is just north of the west end of the WSA in the vicinity of the Stirling mine; some of these plot about on the border of the WSA.

The third cluster of unpatented claims is in the south-central part of the GRA, also about on the boundary of the WSA. They are in Secs. 7, 8 and 18, T 19 S, R 55 E. Some of them are Mr. Hughes' (#4).

4. Mineral Deposit Types

The gold ore of the Johnnie district occurs in prominent quartz veins in the Zabriskie Quartzite and the dolomitic rocks near the top of the Wood Canyon Formation. Ivosevic (1976) considers that the blanketing effect of the shaly rocks at the base of the Carrera Formation, which overlies the thin Zabriskie Quartzite, had considerable influence in localizing ore formation in the Zabriskie and Wood Canyon. He also notes the regional favorability of the dolomitic rocks at the base of the Wood Canyon Formation.

The area around the Stirling mine just north of the WSA has the same sequence of rocks exposed as does the Johnnie district, and some structural elements similar to those at Johnnie -- northeast-striking faults (Longwell and others, 1965). The mineralization here is probably similar to that of Johnnie.

The lead-zinc-silver ores of the Charleston district are reported to occur as replacement bodies in dolomitized limestone (Longwell and others, 1965). According to their plotting on the county map each of them lies on or close to one or another of the several northeast-striking thrust faults that transect the Spring Mountains. Three of them may be in the Mississippian Monte Cristo Formation, which is the principal host rock for major lead-zinc-silver replacement ore bodies in the Goodsprings (Yellow Pine) district 30 miles to the south (Albritton and others, 1954). The cluster of unpatented claims on the southeastern border of the WSA is near one of the thrust faults where it thrusts siliceous and carbonate rocks over carbonate rocks (Longwell and others, 1965, do not show Monte Cristo Formation as being present).

5. Mineral Economics

Orebodies similar to those of the Johnnie district -- with about one million dollars in gold at the old price and perhaps $10 million at prices in the 1980s -- are marginal, at best, for even a small mining company even if they were found virgin. It is possible that a very small organization -- with all its personnel and capabilities concentrated at the mine, and no off-site headquarters -- could make such an ore body pay. If an entire virgin district comparable to the Johnnie district were found, it might be highly profitable for a small organization. It is unlikely that a major mining company would prospect an area that looks as though it might contain only a Johnnie district.

Lead-zinc-silver ore bodies comparable to some of the larger ones of the Goodsprings district would be of interest to small and perhaps medium-sized mining companies, but bodies the size of those known in the Charleston district are not likely to be mineable by any organization or individual.

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

The major uses of silver are in photographic film, sterlingware, and increasingly in electrical contacts and conductors. It is also widely used for storage of wealth in the form of jewelry, "coins" or bullion. Like gold it is commonly measured in troy ounces, which weigh 31.1 grand grams, twelve of which make one troy pound. World production is about 350 million ounces per year, of which the United States produces about one-tenth, while it uses more than one-third of world production. About two-thirds of all silver is produced as a by-product in the mining of other metals, so the supply cannot readily adjust to demand. It is a strategic metal. Demand is expected to increase in the next decades because of growing industrial use. At the end of 1982 the price of silver was $11.70 per ounce.

The largest use for lead is in electrical storage batteries, the second being a gasoline antiknock additive. It has many other uses, however, including radiation shielding, solders, numerous chemical applications and in construction. About four million metric tons of lead are produced in the world annually. The United States produces about half a million tons per year, and recovers about the same amount from scrap -- much of it through the recycling of old batteries. It imports about one-quarter of a million tons. Lead is classified as a strategic mineral. Demand is projected to increase somewhat in the next couple of decades, but environmental concerns will limit the increase. The United States has large ore reserves that are expected to last well beyond the end of this century at current production rates even without major new discoveries. At the end of 1982 the price was about 22 cents per pound.

The major uses of zinc are in galvanizing, brass and bronze products, castings, rolled zinc and in pigments or other chemicals. About six million metric tons are produced annually, with the United States producing somewhat less than a quarter of a million tons. Domestic production has decreased dramatically over the past five years, largely as the result of closing down of most zinc smelters because of environmental problems. Imports into the United States are about one million tons per year, and zinc is listed as a strategic and critical metal. Both world-wide and domestic consumption are expected to increase at a moderate rate over the next twenty years. At the end of 1982 the price of zinc was about 38 cents per pound.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

No nonmetallic mineral deposits are known in the Mt. Stirling GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

No nonmetallic mineral prospects are known in the Mt. Stirling GRA. The thick sequence of limestones and dolomites is certain to include some units that would be suitable for producing lime, cement or other commodities; these might be considered nonmetallic occurrences or mineralized areas. In the northeastern part of the GRA and WSA quaternary alluvium is mapped. Alluvium by definition contains sand and gravel.

3. Mining Claims, Leases and Material Sites

No mining claims can be identified as having been located for nonmetallic minerals in the GRA. There are no mineral leases in the GRA. No material sites are known in the GRA.

4. Mineral Deposit Types

Limestone or dolomite deposits occur as beds within certain formations. For some uses, the rock must be very pure, while for other purposes, such as making cement, impurities add to the suitability of the rock.

5. Mineral Economics

Limestone and dolomite and the materials produced from them (notably lime and cement) are low-value, high-volume commodities, meaning that their selling prices per ton are low but many tons are produced from most operations. Since their selling price is low they must be mined close to their point of use, or at least close to inexpensive transportation to the point of use -- close to a railroad. The Mt. Stirling GRA is at least 50 miles by road from the marketing area of Las Vegas and the nearest rail point, and there are numerous limestone and dolomite deposits much closer. It is unlikely that any use will be made of these rocks from the GRA.

Sand and gravel deposits are abundant in the Las Vegas Valley, and it is unlikely that deposits in the WSA will ever be mined.

Pure limestone and dolomite are used principally to produce lime, but some is used as rock for building stone, crushed rock, and similar applications. The principal uses of lime are in steel smelting, water purification, as an alkali, in paper and pulp manufacture, and sewage treatment. Other uses for lime are in sugar purification, mortar, and as an agricultural soil conditioner. Limestone with certain clay impurities (called cement rock), or purer limestone with clay added, is used to make cement that is mostly consumed in construction. The United States uses about 20 million tons of lime and 85 million tons of cement annually. For both lime and cement the raw material must be mined within a very few miles of the processing plant, because it has a very low value in the form of run-of-mine rock -- two or three dollars per ton. There are numerous lime and cement plants in the United States, and most of them sell most of their product within a 200-mile radius of the plant. Some cement is imported in the form of clinker, which is the kiln-fired rock that is then ground in the United States. In the early 1980s the price F.O.B. plant of both lime and cement is about $40 per ton.

The most common use of sand and gravel is as "aggregate" -- as part of a mixture with cement to form concrete. The second largest use is as road base, or fill. About 97 percent of all sand and gravel used in the United States is in these applications in the construction industry. The remaining three percent is used for glassmaking, foundry sands, abrasives, filters and similar applications. The United States uses nearly one billion tons of sand and gravel annually, all of it produced domestically except for a very small tonnage of sand that is imported for highly specialized uses. Since construction is by far the greatest user of sand and gravel, the largest production is near sites of intensive construction, usually metropolitan areas. Since sand and gravel are extremely common nearly everywhere, the price is generally very low and mines are very close to the point of consumption -- within a few miles as a rule. However, for some applications such as high-quality concrete there are quite high specifications for sand and gravel, and acceptable material must be hauled twenty miles and more. Demand for sand and gravel fluctuates with activity in the construction industry, and is relatively low during the recession of the early 1980s. Demand is expected to increase by about one third by the year 2000. In the early 1980s the price of sand and gravel F.O.B. plant averaged about $2.50 per ton but varied widely depending upon quality and to some extent upon location.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits within or near the WSA or the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known uranium or thorium prospects or occurrences within the WSA. However, there is one small uranium occurrence within the GRA, just north of the WSA (see Uranium Land Classification and Mineral Occurrence Map). Secondary yellow uranium minerals occur in fractures of the Cambrian Sterling Quartzite along with copper and iron oxides in Sec. 18(?), T 17 S, R 54 E at the Bunker-Stone No. 1 claim (Garside, 1973).

3. Mining Claims

The only known uranium claim in the area is the Bunker-Stone No. 1 claim and it has probably lapsed. There are no known thorium claims or leases in the GRA.

4. Mineral Deposit Types

Uranium and thorium deposit types are not discussed due to the lack of known uranium or thorium occurrences in the area.

5. Mineral Economics

Uranium and thorium would appear to have little economic value for the area due to the lack of known radioactive mineral occurrences.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Oil and Gas Resources

1. Known Oil and Gas Deposits

There are no known oil and gas deposits in the GRA.

2. Known Prospects, Oil and Gas Occurrences and Petroliferous Areas

No oil seeps are present in the GRA or vicinity. Although no exploratory wells have been drilled in the GRA, Tri-State Oil Exploration Co. drilled Miskell-Government No. 1 (#1 on the Oil and Gas Occurrence and Land Classification Map) to 2,602 feet in 1959 (Schilling and Garside, 1968).

3. Oil and Gas Leases

There are about 12 square miles of Federal leases in the WSA and essentially complete coverage in the GRA.

4. Oil and Gas Deposit Types

Oil deposits that have been found and developed, and those that are being explored for in the Basin and Range to date, have been limited to the Upper Paleozoic section of the miogeosyncline and the Tertiary section of the intermontane basins. The source rocks are assumed to be in Paleozoic horizons, such as the Mississippian Chainman Shale, and perhaps also the Tertiary section.

The reservoirs at the Trap Spring and Eagle Springs oil field in Railroad Valley are the Oligocene Garrett Ranch volcanics or equivalent, which produce from fracture porosity; or the Eocene Sheep Pass Formation, a freshwater limestone. Minor production has been recorded from the Ely(?) Formation of Pennsylvanian age at Eagle Springs.

It may be that production also comes from other units in the Tertiary or Paleozoic sections in the Blackburn oil field in Pine Valley or the Currant and Bacon Flat oil fields in Railraod Valley.

5. Oil and Gas Economics

The low level of production from Nevada Basin and Range oil fields, which are remote from existing pipelines, existing refineries and consuming areas, necessitates the trucking of the crude oil to existing refineries in Utah, California and Nevada. Since the discovery of oil in Nevada in 1953, the level of production has fluctuated. Factors which have affected the production from individual wells are: reservoir and oil characteristics; Federal regulations; productivity; environmental constraints; willingness or ability of a refiner to take certain types of oil; and of course, the price to the producer, which is tied to regional, national and international prices.

Geothermal Resources

1. Known Geothermal Deposits

There are no known geothermal deposits in the GRA.

2. Known Prospects, Geothermal Occurrences and Geothermal Areas

No prospects, occurrences or thermal areas are known in the GRA, although there are slightly thermal springs in the vicinity. In Pahrump Valley to the southwest there are over a dozen wells and springs in the 70° to 82°F range; and north of the GRA the wells and springs are in the same temperature range. North of the GRA Indian Springs (79°F), Test Well 10 (81°F) and Army Well No. 1 (94.5°F), shown on the Mineral Occurrence and Land Classification Map as #1-#3, indicate the presence of slightly thermal water (Garside and Schilling, 1979).

3. Geothermal Leases

There are no recorded leases on Federal lands in the GRA or vicinity.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year-round mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), and drying of diatomaceous earth (338°F).

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is an historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in the GRA. There is no reason to expect coal resources.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

Lead is a strategic metal, and zinc is a strategic and critical metal.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

The geologic maps at 1:250,000 provided by Longwell and others (1965) and Cornwall (1972) give good general coverage of rock distribution and major faulting in the GRA but more detailed mapping is lacking for virtually all of WSA NV 050-401. The only available information about mineralization concerns the Johnnie district, just outside the northwest corner of the WSA. There is no information, other than that collected during field verification, concerning prospects known to lie just outside and within the northwest corner of the WSA, and at its southern edge. Overall, the quality and quantity of geological mapping is good except in the northwest corner of the WSA where more detailed mapping would be valuable. The quantity and quality of data available concerning mineralization and mineral occurrences is adequate for most of the GRA -- there evidently are virtually no occurrences -- but is very low for the northwestern corner and the south edge of the WSA where prospects are known to be present but nothing is known of their nature. The overall level of confidence in the data is moderate for most of the WSA and low for its northwest corner and south edge.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g., M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable reosources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may be also included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-410

M1-3B. This classification area covers the northwestern end of the WSA. At the west end of it, and outside the WSA, is the productive Johnnie gold district. At the east end of it, mostly outside of the WSA but with some prospects inside it, is what might be called the Stirling gold district after the one "mine" in it; it is not known whether this mine actually produced any metals of value. The similar nature of the mineralization at both Johnnie and Stirling, and the similar rocks that they occur in, indicate that both districts are of similar origin. This raises the possibility that they actually constitute a single rather large district. The postulated district is the area of M1-3B, and the classification of 3 is based on this concept and the known mines and prospects in the overall "district". The level of confidence is low because, while some of the prospects at the east end lie within the WSA, most of the WSA within the "district" is not known to have prospects.

M2-1B. This classification area covers most of the WSA. In it no prospects are known to be present, and there are no intrusives that might serve as sources of mineralizing solutions. These are the reasons for the classification of very low favorability. The low level of confidence stems from the fact that the absence of intrusives is not necessarily a negative feature, for intrusives are not known at the productive Johnnie district, nor anywhere else in the Spring Mountains, although there are occurrences of lead-zinc silver ore.

M3-4C. This classification area covers a small part of the southern end of the WSA. It is a rather narrow strip along the thrust fault mapped here. Mr. Hughes' El Lobo property, which has produced lead, lies in it, and according to Mr. Hughes lead mineralization is widespread in the vicinity of the property. The known presence of lead ore in the structurally disturbed area of the thrust fault suggests that there may be widespread mineralization in the fault zone. Although the thrust fault as mapped lies outside the WSA, it dips into the WSA, and if ore is found in the thrust zone it will probably extend into the WSA at depth. The structural situation and the presence of a productive mine are the reason for the classification of high favorability. The level of confidence is only moderate despite the presence of the mine, because there is only the one mine and the extent of mineralization is only inferred.

M4-2A. This classification area covers a small strip of the southeastern corner of the WSA. Here the thrust fault from M3-4C (offset on a northwest-striking fault) lies along the edge of the WSA. Mineralization along the fault is possible, but no mineralization is known or indicated by old prospects; this is the reason for the classification of low favorability. The lack of confidence in this classification stems from the lack of indications of mineralization.

b. Uranium and Thorium

WSA NV 050-401

U1-2B. This land classification area covers most of the WSA. The area has low favorability with low confidence for uranium mineralization in fractures of the Precambrian and Paleozoic metasediments which cover the area. Uranium may be associated with copper mineralization within the area, as indicated by the presence of one uranium occurrence north of the WSA associated with copper and iron oxides in fractures of the Cambrian Stirling Quartzite. This is the Bunker-Stone No. 1 claim in Sec. 18(?), T 17 S, R 54 E.

The area has very low favorability with very low confidence for thorium due to the apparent lack of granitic or pegmatitic source rocks.

U2-1A. This land classification indicating very low favorability with very low confidence for uranium and thorium cover a small section in the northern part of the WSA and also the northeastern and southwestern parts of the GRA which are covered by Quaternary alluvium. Both uranium and thorium are not prospective in the area due to the apparent lack of source rocks (Tertiary volcanics or granitic intrusives) for these elements.

c. Nonmetallic Minerals

WSA NV 050-401

N1-2B. This classification area covers much of the western part of the WSA. In it the formations mapped are principally clastic rocks: shales, siltstones, sandstones and quartzite. No nonmetallic occurrences are known, but because of the potential that any mineral material has for becoming an economic nonmetallic mineral commodity, given someone who can find a market for it if only as construction material, it is assigned low favorability with a low level of confidence.

N2-3C. This classification area covers most of the WSA. In it the formations mapped are principally limestone and dolomite, which elsewhere are mined in large quantities for various applications. The known presence of limestone and dolomite are the reason for the classification of moderate favorability and the moderate level of confidence in this classification.

N3-3C. This classification area covers part of the northeast corner of the WSA in which Quaternary alluvium is mapped. (There are very small areas of similar material along the west side of the WSA which have been ignored.) The alluvium by definition contains sand and gravel, which is the reason for the classification of moderately favorable. The level of confidence is only moderate because the quality of the sand and gravel is undoubtedly highly variable and is not known for any particular place, nor overall.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 050-401

OG-1A. Although oil and gas leasing is present in some of the WSA, this portion of the Spring Mountains is believed to be outside of the Overthrust Belt that passes through southern Nevada (Keith, 1979). The presence of Precambrian and Cambrian through Silurian rocks, which crop out or are believed to be beneath the alluvium in the WSA, does not provide for a source rock presence here.

b. Geothermal

WSA NV 050-401

G1-2A. The thermal springs and wells surrounding the WSA are largely at the lower end of what can be called geothermal occurrences, especially at this latitude and elevation. The structural framework for a geothermal system appears to be present throughout the WSA, but there are no surface thermal manifestations which indicate anything but very low-temperature resources in the region.

The absence of any Federal leases also shows a lack of interest in this area for commercial development of geothermal resources.

c. Sodium and Potassium

S1-1D. There is no known potential for sodium and potassium in the WSA. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been covered in the section on Nonmetallic Minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. The postulated district lying between the Johnnie and Stirling areas should be geologically reconnoitered and geochemically sampled. A fairly detailed stream sediment sampling program with attendant geological mapping would be appropriate for the first pass.

2. The areas along the thrust fault at the southeast edge of the WSA -- classification areas M3-4C and M4-2A, should be geochemically sampled to determine if there is indeed widespread lead-silver mineralization in the thrust zone. A fairly widely-spaced soil sampling program would be appropriate.

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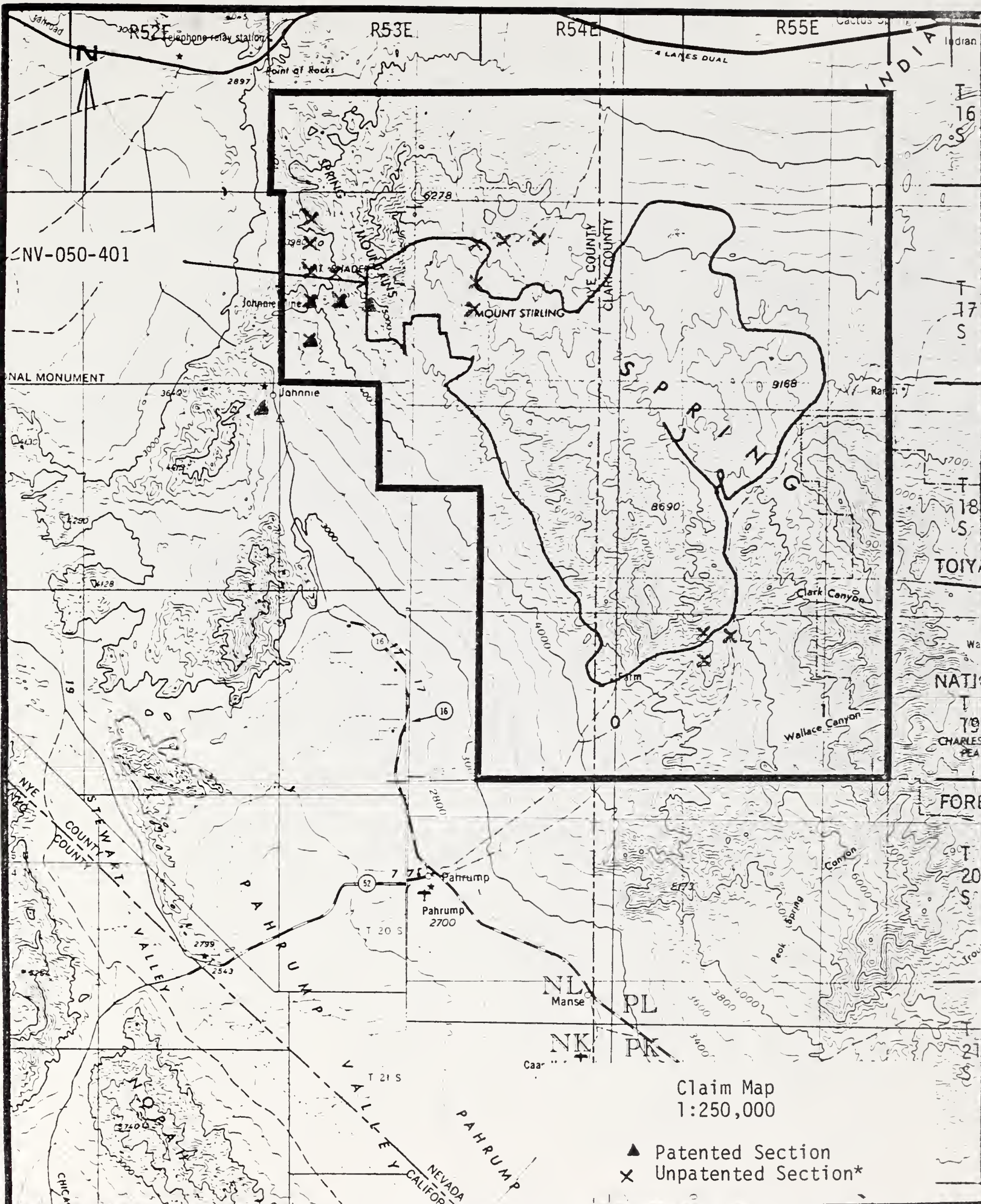
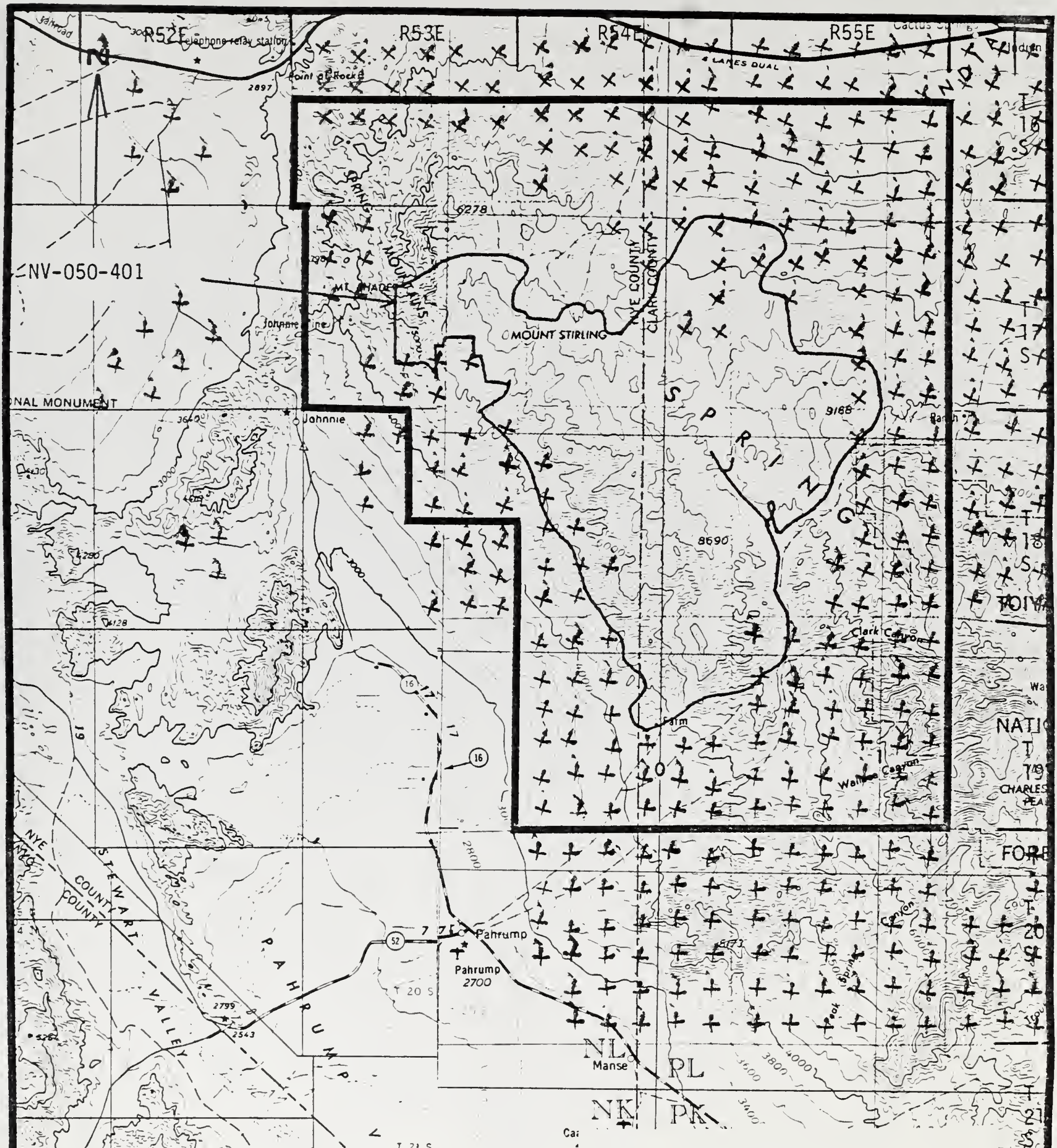


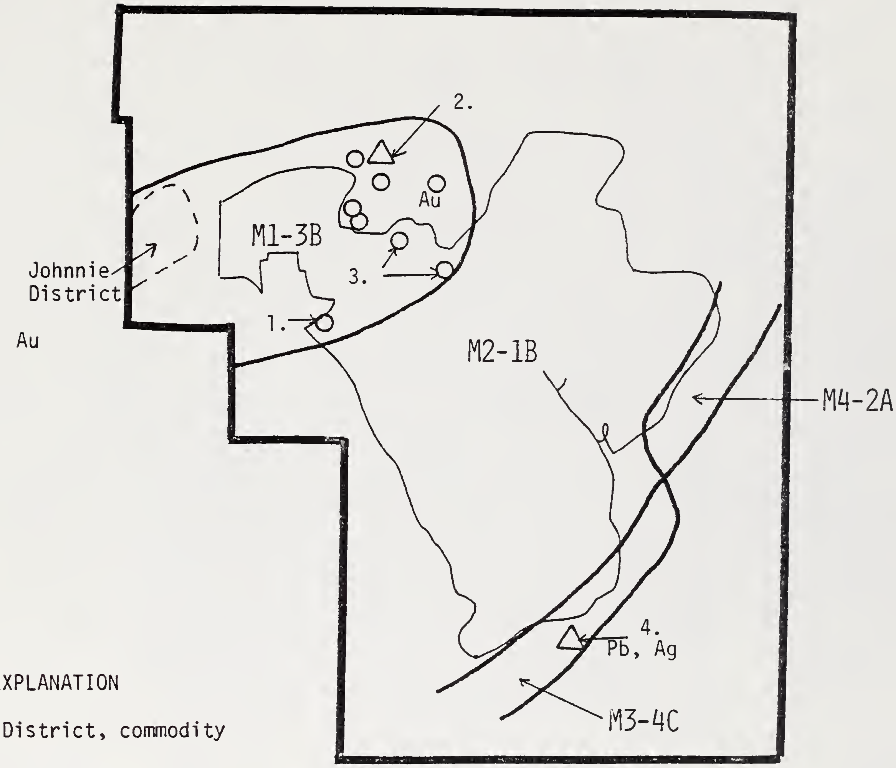
*X denotes one or more claims per section

Mount Stirling GRA NV-31



Oil and Gas Lease Map
1:250,000

X Leased Section



EXPLANATION

- - - Mining District, commodity

△ Mine, commodity

○ Occurrence, commodity

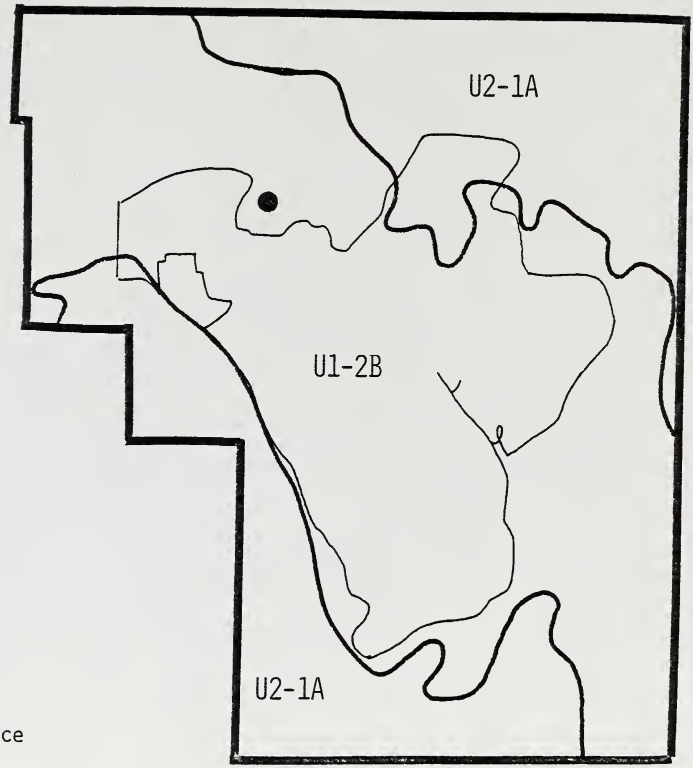
━━ Land Classification Boundary

── WSA Boundary

1. Reference location (see text)

Land Classification - Mineral Occurrence Map/Metallics

Mount Stirling GRA NV-31
Scale 1:250,000



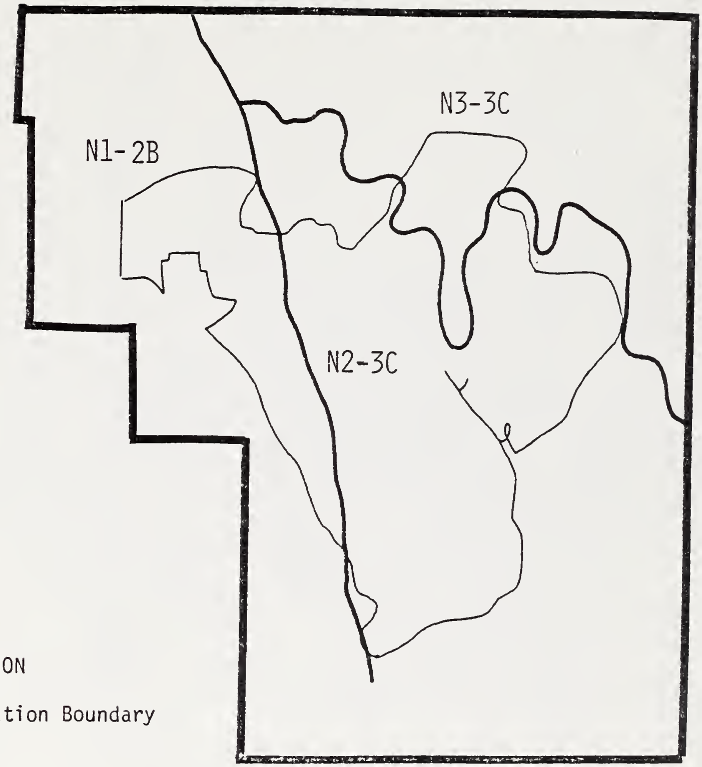
EXPLANATION

● Uranium Occurrence

━ Land Classification Boundary

— WSA Boundary

Land Classification - Mineral Occurrence Map/Uranium Mount Stirling GRA NV-31
Scale 1:250,000



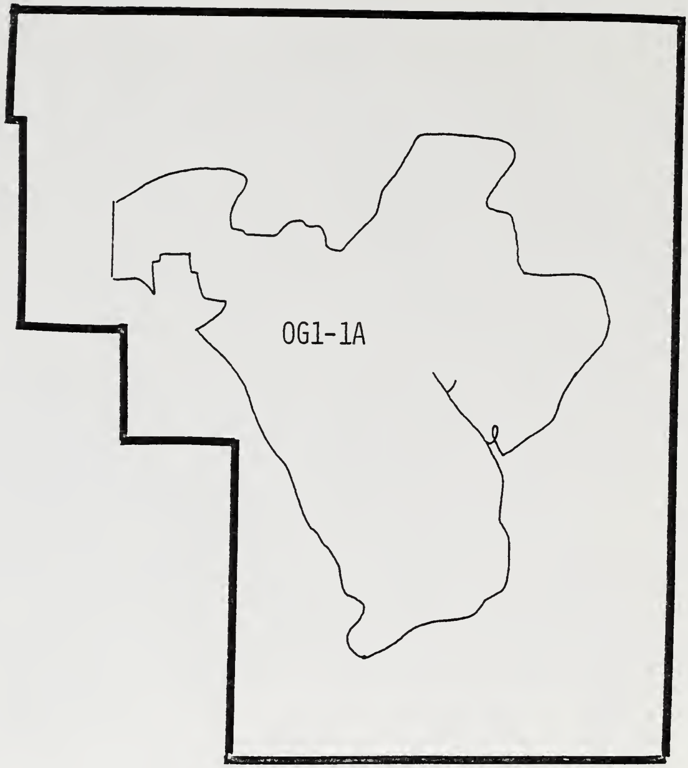
EXPLANATION

Land Classification Boundary

WSA Boundary

Land Classification - Mineral Occurrence Map/Nonmetallics

Mount Stirling GRA NV-31
Scale 1:250,000



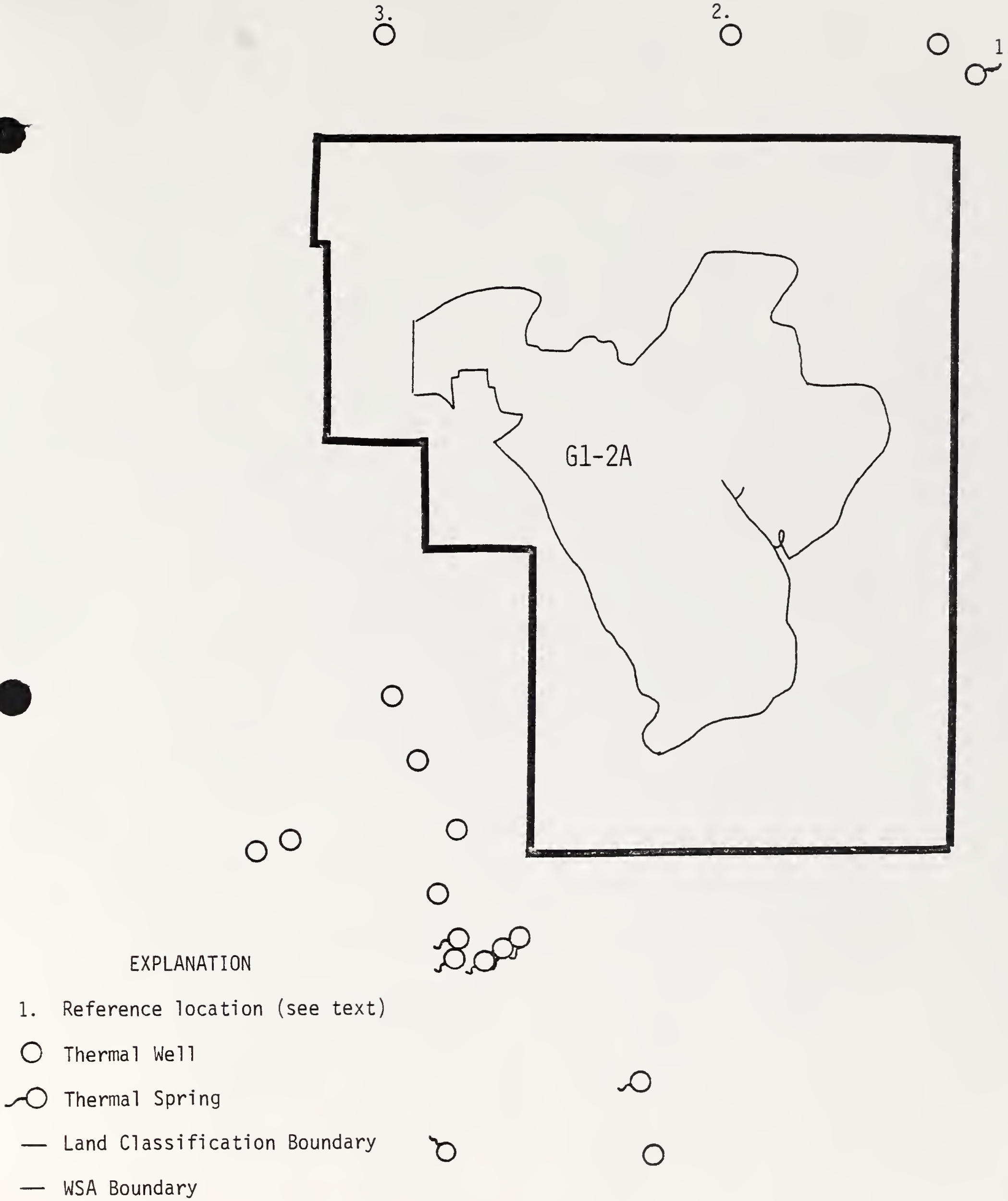
EXPLANATION

Dry hole

WSA and Land Classification Boundary

1. Reference location (see text)

1.



Land Classification - Mineral Occurrence Map/Geothermal

Mount Stirling GRA NV-31
Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene; and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970